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ABSTRACT

This paper focuses on a middle school in a reform process which includes a curriculum developed jointly by teachers and university personnel. Descriptions of the funding sources, history of the reform project's development and implementation, and the philosophy supporting the reform at various levels are provided. Profiles of the teachers and their perspectives on reform at the classroom level are used to argue for systemic and institutional support for school reform. A number of recommendations are made and include increases in teacher planning time, technology development, better student assessment techniques, more provisions to ensure continuity of the program, and better strategies for bringing new teachers into the reform process. The author concludes that reform is difficult and always subject to constraints from a variety of levels. (DDR)

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Teachers' Personal Learning Theories: Seven Stories of Teachers Engaged in a Science Reform

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The research reported in this paper was prepared for the Curriculum Reform Project, a study of curriculum change in mathematics, science and critical thinking which is funded by a grant from the U.S. Department of Education's Office of Educational Research and Improvement (OERI Grant #R91182001). The opinions expressed herein are those of the author and the participants in this study.

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INTRODUCTION

> Kids learn by doing. If they do an activity or an experiment ... and then being quizzed on it everyday. Drill and practice, that's how I learned.

These words spoken by a student teacher at a science education reform site reflect the role teacher beliefs play in translating school reform into classroom practice. Beliefs and actions are linked. Prior beliefs not only have an effect on what pre-service teachers learn from their teacher education program, but they also influence how teachers modify the curriculum (Cronin-Jones, 1991) and "are major determinants of what they (teachers) do in the classroom" (Borko and Putnam, in press, p. 7).

At this time it is not clear if it is necessary to change beliefs before there can be a change in behavior, or if a change in behavior can bring about changes in the belief system. In reviewing a number of studies of pre-service and novice teachers' beliefs about teaching, in general, and their conceptions of themselves as teachers, Borko and Putnam (in press) found that some beliefs could be changed by classroom experiences.

BACKGROUND

The information for this paper is taken from a case study of a middle school engaged in The State Project for Reform in Science Education (SPRSE)[1], which is based on the principles of National Science Teachers Association (NSTA) Scope, Sequence and Coordination (SS&C). The SPRSE developers used materials from a number of other sources--American Association for the Advancement of Science (AAAS) Project 2061, National Assessment of Educational Progress (NAEP) Goals, National Research Council's Science Standards, and The American Geological Institute's Earth Science Framework--to draft the curriculum framework for this project. Teachers working with university personnel were actively involved in writing and implementing the curriculum at the classroom level.

THE SCHOOL

Fairview Middle School (grades 6-8) is located in the little town of Cedarville, where a large, rapidly growing city of approximately 50,000 people encroaches on its boundaries. The student population of 800 students is evenly distributed among the three grades (254 in grade 6, 252 grade 7, and 242 grade 8). The school draws from a low income area of the city, a middle income suburban area, as well as the original rural community of the area, and reflects the 50% minority composition of the district, due to federally mandated integration.

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[1]The names of all persons, places, and institutions used in this paper are pseudonyms.

The school operates under the strong leadership of a principal who came up through the ranks and has a reputation for "getting things done." This past year he lobbied three area businesses to contribute over $90,000 for a computer lab. Shared decision-making is accomplished through the Planning Leadership Team (PLT), which includes all the team leaders (Each grade has a minimum of two teams)--the lunchroom manager, head custodian and a teacher's aid are added if a decision involves the whole school. Plans for the future include parents.

A VISION FOR REFORM

The vision for the science education reform at this site can best be described by the looking at the elements and principles of National Science Teachers Association's (NSTA) Scope, Sequence and Coordination (SS&C).

Elements and Principles of the Reform

The developers' purpose was to form a synthesis from the best research and development efforts in education. They focused on developing a greater depth of understanding for the student and less coverage of science content, while maintaining the appropriate sequencing and consideration for child developmental levels (Aldridege, 1992). SS&C is based on the following principles:

1. The "spacing effect" which states that for a given amount of study time, spaced presentations yield substantially better learning than do massed presentations.
2. Learning is not improved by ability grouping.
3. Students learn from each other in cooperative learning situations.
4. All students should learn science.
5. Students should learn through practice, problem-solving and carrying out experiments.
6. New information should be connected to prior student knowledge.[2]

THE TEACHERS

At the classroom level the reform is teacher-dependent. The administrators of this reform make an important point that the reform is voluntary and that each teacher has the freedom to make changes and present the curriculum as he/she feels is necessary.

The teachers at Fairview Middle School come from diverse backgrounds and have different ideas of their students' needs and how to meet these needs. Some teachers come from an elementary

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[2]NSTA (1992). SS&C Vol. II Relevant Research. Washington, D.C.

background while others have experience in the secondary schools. Several of the teachers are teaching out of their subject area(s) and/or identify themselves primarily as a teacher of another subject, such as math.

Teacher profiles

Sara is a pilot teacher who has been with the project from the beginning. She--along with a colleague who has since moved to a another state--wrote the 6th grade curriculum and she continues to try new activities and rewrite curriculum each year. Others in the school, and even in the district, look to her as the leader of the reform program. She characterizes herself as a teacher who likes to try different things.

> I embrace change. I like when things don't stay the same I'm always looking for something that makes me better at what I do, that gets it across better to my students. That makes them more excited about science.

She finds the project exciting and commits much time and effort, not only the program for her own students but the whole project. She works closely with the university and is involved in the summer training institute and meetings throughout the year. Her classroom is a model for the project and she is often video-taped for presentations to other faculties, researchers, and interested parties.

She believes in the philosophy of the project and maintains that she would teach according to the project--even if she went to another school. Next year she takes on new responsibilities as the district resource person in math and science. She hopes to make an impact and help teachers at other schools implement the reform program.

Michael is a first year teacher who majored in physical education. During his relative short time in the classroom he has established excellent rapport with his students. They sincerely like being in his class and are eager to share their lives with him. He is always seeking ways to make science more meaningful for his students. On my first two visits to the school he liked the project and said that both he and his students were finding science fun.

As the school year wore on he began to have doubts. He said that it seemed that they were always doing activities but the science reform lessons did not conform to his view of science. He had a difficult time justifying the grades he gave his students and felt the need for tools to grade his students more objectively. To fill this need he began creating his own worksheets, quizzes and tests.

Several times he commented that he would feel more comfortable with a textbook and felt the project was too great a change.

> Maybe the project should be a little bit and be more in the middle of the road. There could be a little less activity and more substantive material.

Taylor is an energetic and enthusiastic 6th grade teacher who is relatively new--a second year teacher--to the profession but is involved in many aspects of the school. She describes herself as "a computational math person" but has shown creativity in student activities and assignments.

Last year she taught 8th grade science, a textbook-based program. At the beginning of the year she, like Michael, was very excited about the project and often expressed her own satisfaction and some amazement of how much students learned and remembered from SPRSE lessons.

Her enthusiasm has waned after a parent confrontation. She was put in the position of defending the project and justifying a student's grade--"something" she was not prepared to do. Since then she has generated some of her own written materials to give students more objective grades.

Both Michael and Taylor do not have the same feeling of ownership as the original pilot teachers. They report that they were just given a curriculum package to follow--but they do not feel so constrained that they cannot modify or change what they do in class.

Paul and Connie are 7th grade teachers who joined the project the second year. They have worked closely together to write the 7th grade curriculum and their teaching has evolved along with the project. They both continue to make changes as they try new ideas.

> Well through the year Paul and I worked really closely together on, we would discuss the lessons, and I might try one thing, he might try another. We both might try the same thing, and we'd discuss what we thought worked, what we felt like we needed to put into that.

Connie stated that it is a good working relationship because they (Paul and Connie) are different and are able to draw from each other's strengths.

Both of them see the dialogue or the verbalization with the students as the most important change in the reform process. The questions asked of students are now oriented to guiding students to make their own sense of observations instead of regurgitating textbook facts.

Sara, Paul and Connie, feel they have "ownership" of the program and feel comfortable with making changes because "the curriculum was written by teachers just like me...in fact, I was one of the teachers." They also have classrooms that are in close proximity to each other which facilitates collaboration--although most of the collaboration occurs between the two 7th grade teachers.

This is the first year for the 8th grade program. Diane has taught gifted students and a computer lab course for eleven years. She describes herself as a teacher who has kept abreast of the changes in education by attending conventions, reading professional journals, and then trying to incorporate these changes into her classroom. She believes she has made the change from teacher-centered instruction to a student-centered classroom.

On observation I found that she was using the reform materials and hands-on activities in a very controlling manner. She walked her students through the activities step-by- step, telling them what to do and then checking their results. Student decision-making and student engagement in group discussions was missing from her classes. She explained her classroom procedure by stating that it was necessary to conduct class in this manner in order to establish the procedures and get the students into their roles.

In later discussions Diane stated that this year has been the "worst year" of her teaching experience. She felt that this year's student population, the extra demands of SPRSE, and a number of other concurrent school changes created a difficult situation. One of her major problems was an incomplete SPRSE curriculum--only one-third of the curriculum was written before beginning this school year. She felt she had to complete the school year totally alone--trying to write curriculum while teaching. She reported that she would continue to work on a curriculum that is consistent with the philosophy of SPRSE and is looking forward to a better experience next year with a complete curriculum.

Linda, the other 8th grade science teacher, has been a science teacher for fifteen years. She possesses a genuine concern for her students and takes her responsibility as a teacher seriously--feeling an obligation to prepare them for the future.

At the beginning she was very open and honest about her reservations with the reform. She feels she has been doing a good job and does not see anything wrong with how she has been teaching. In fact, she worries that the reform project may be treating the students as "guinea pigs" and ultimately doing more harm then good. She has seen reform projects "come and go. Every time there's money for a project, people jump on the band wagon, but when the money's gone, so is the project."

The amount of science content especially concerned Linda. She said that there were some things that the students had to know--like the symbols for the elements. The only way to know these things is to memorize them. She was also uncomfortable with the "spiraling" of the reform curriculum. In her opinion covering a topic in more depth once was more beneficial than revisiting the topic several times. Another area of discomfort was splitting the science disciplines. She preferred to cover all astronomy topics, then all geology topics, etc.

For most of the first semester Linda did adhere to the new curriculum. She had her students working in cooperative groups and used many hands-on activities. During later discussions Linda stated that these activities were not new to her. Her class engaged in such activities prior to SPRSE.

During classroom observations I noted that many of the hands-on activities seemed disconnected and that classes often ended with the students copying notes from the overhead projector. Linda admitted that making connections between content and activities was a problem for her. She felt "spiraling" caused connections to be forced. She listed her discomfort with the project and a concern that the students were not getting enough subject-matter knowledge as the reasons for students copying overhead notes.

In December Linda told me she had "used up" all the curriculum written for the project. Therefore, she was going back to her original way of teaching and had reissued textbooks. She stated that the purpose of the textbooks was to serve as a guide and She would still use cooperative groups and hands-on activities.

Discussion

The teachers play a key role in SPRSE. In addition to their normal role as classroom practitioners, they also assume the duties of curriculum writers and developers. Many teachers assume these new duties willingly and find teaching takes on a new excitement. This is especially true of the teachers who were "on the ground floor of this project." They feel they have ownership and work to continually improve what they have written. Others seem to lack a commitment to the project and resent the extra time and effort required by the project. Teaching according to the project does involve more time planning, collaborating, and attending meetings.

As an observer I see a real difference between experienced SPRSE teachers and new teachers. Some differences can be attributed to the normal struggle a teacher encounters as he/she wrestles with the project for the first time. More experienced teachers recount their own first year experiences as being difficult and struggling to resolve many issues. After a teacher has taught SPRSE for a year he/she needs a summer to reflect over

the past year and make changes. All teachers relate a more positive experience the second year.

In-service staff members report a change in the in-service institute during the summer, 1993. Participating teachers recommended that more time be spent writing curriculum. To comply with this request the staff deleted time from other areas--such as the program philosophy. The result of this change is teachers who do not have a clear understanding of the project. They describe SPRSE as "hands-on" or activities instead of defining the broader scope of the reform.

Another concern is the recent monetary cuts. The university pledges its support but they must do it with less funding. Therefore support measures--like the frequency of school visits must be cut. Also, many teachers do not attend the state-wide follow-up meetings. Their excuses range from not enough notice to family commitments.

In the 8th grade the "best" students are selected out of SPRSE classes and take accelerated physical science. The 8th grade teachers report they have a difficult time conducting cooperative learning in a class without "good" students. This coupled with teacher concerns that they have to prepare the students for high school, help undermine the project at the 8th grade level.

Another problem is bringing new teachers into the established project and giving them "ownership". New teachers express discomfort with someone else's material. One teacher expressed his opinion, "Sara wrote the material and she can do it very well, but I just can't do what she does." Other new teachers claimed that besides the amount of work and the time involved, the biggest problems were as follows:

1. keeping the momentum of the class going
2. incorporating activities that supported the science concepts
3. the management of materials
4. student behavior.

Cooperative groups allowed for more social interaction of students. Inexperienced teachers had a difficult time handling these situations. They often expressed a desire for a textbook to use when students were out of control. Due to the middle school structure they also had a difficult time finding time to work with other science teachers--especially when their rooms where physically removed from other science teachers.

Recommendations

Because the program is voluntary and teacher-generated it is teacher-dependant. Individual teacher beliefs concerning the nature of science, and teaching and learning determine the reform look of the reform in each classroom.

University personnel and teachers, who have the task of training new teachers in SPRSE, are aware of the importance of teacher beliefs. They have taken steps to address this problem in the summer institute. For the first two years their efforts appear to be more successful--at least for the teachers at Fairview Middle School--than last year. Restructuring the institute to provide more time for curriculum development may be a factor. To have a successful and lasting change in the schools, the teachers must believe in the reform and recognize its benefits. Therefore, addressing teacher beliefs is the most important part of the summer institute and should be included.

As funding decreased, so has support from the universities. The curriculum director for the project suggested the following changes in teacher support and curriculum materials given to the teachers.

> I think definitely one thing we would do would be to structure a situation whereby the teacher in the schools, pilot schools, would be contacted at least once a month, visited at least once a month. I think those three coordinated meeting or state-wide meetings are very good - not everybody can come to those. But then they go back and report to their colleagues what was discussed. But I think it's a lot to do with, what are your resources out there? The longer I stay in this I find more and more resources that are very good resources, whether they're curriculum packages, whether they're in the information from TERC, whether it's a computer program. And it's just taking a while to get a hold of all those things. So if you could open up with, "Well here's a portfolio of everything going on as far as other people developing curriculum, and here's what they do." And they might have some steps in there. Now that would just be very helpful.

Another problem is maintaining the continuity of the program with the normal attrition of personnel. As teachers--who participated in the original curriculum writing and development--leave they are replaced by new teachers who do not have a commitment to SPRSE and feeling of ownership. New teachers need to be "brought into the fold." Department meetings or other science department "get-togethers" can help to solve this problem and increase the communication among science teachers.

Included in the original proposal for SPRSE was the development of technology to supplement the curriculum. When teachers were asked what improvements or changes they would like to see in SPRSE, they answered without exception the development of companion computer technology. The national literature on SS&C describes a pupil assessment program on CD-ROM. These developments would be positive additions to the science reform program.

Providing for the additional teacher time required to plan and develope SPRSE is difficult. If monies are available, teachers could be paid for the additional time and/or given release or compensation time. The teacher time demands decrease with time.

Although problems exist sustaining the reform effort, this site has many positive features, including a supportive administration at both the building and the district level. The principal and the district value the expertise of their teachers and are committed to providing support and allowing them to choose the curriculum.

CONCLUSION

Educational reform whether in science or some other area is difficult and requires much hard work and commitment on the part of the participants. Even harder is maintaining the reform after the initial enthusiasm has waned--then it becomes just a lot of hard work that requires enormous amounts of time.

As time passes many different factors come into play which have the potential to undermine the reform--such as state or federal guidelines, mandates for accountability and loss of funding. The only way reforms can continue is for all levels of the educational hierarchy--state, district, and local school--to work together and to have a support structure in place for teachers.

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